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with the origin of amphivasal bundles. To some it may appear an unnecessarily round-about plan to derive a circle of collateral bundles from a proto-stele *via* the root, when direct routes have been proposed which do not violate the doctrine of recapitulation. Moreover, it would be interesting to see how the stele of *Osmunda* could be derived according to the new method, inasmuch as in ferns the evolution is said (p. 271) not to proceed further than the third or alternate disposition.

The memoir is divided into three parts, in the first of which a fairly complete historical résumé is given. This is rendered more valuable by the grouping of the papers under six headings. It is to be regretted that a number of errors have crept into the citations. The second part is devoted to a summary of the author's earlier researches in this field; while the third part contains an account of his new observations, extending over a wide range of vascular plants, including a large number of dicotyledons, though the critically important cases found in his group "vascular cryptogams" are represented only by *Pteris cretica*.—M. A. CHRYSLER.

Fermentation.—Experiments of HARDEN and NORRIS²⁶ confirm the work of other investigators according to whom many yeasts which ordinarily do not ferment galactose acquire the property of fermenting that sugar by being cultivated for a time on a medium containing it. The authors further show that the juice from such a yeast is also capable of fermenting galactose, and that the addition of phosphates to the fermentation-mixture causes an acceleration of fermentation similar to that observed in mixtures of glucose, fructose, or mannose and yeast juice on the addition of phosphates. As in the case of these hexoses, the phosphate is in the form of an organic compound from which it is not precipitated by magnesium citrate mixture. Small quantities of sodium arsenite also accelerated fermentation.

Regarding the constitution of the compound formed when a phosphate is added to a fermenting mixture of yeast juice and a hexose, three views have been proposed. According to HARDEN and YOUNG it is a hexose-phosphate containing two phosphoric acid residues. LEBEDEV holds that the compound contains only one phosphoric acid residue, basing his view on the fact that the ozazone obtained from it has only a single phosphoric acid residue. The third view is that of IWANOFF, who considers the compound a triose phosphate. In a recent paper, purely chemical in its content, but of great biological interest in so far as it clears up part of the mechanism of fermentation of sugars by yeast juice, YOUNG²⁷ presents further evidence to show that the compound is

²⁶ HARDEN, A., and NORRIS, R. V., The fermentation of galactose by yeast and yeast juice (Preliminary communication). Proc. Roy. Soc. London B **82**:645-649. 1910.

²⁷ YOUNG, W. J., Ueber die Zusammensetzung der durch Hefepresssaft gebildeten Hexosephosphorsäure. II. Biochem. Zeitschr. **32**:177-188. 1911.

a hexose phosphate containing two phosphoric acid residues. The evidence is based largely on the composition of the barium salt of the compound, and on the behavior of its ozones. In the formation of the ozazone, a single phosphoric acid molecule is split off, while the ozazone also contains a phosphoric acid residue.

It has been known that yeasts are able to ferment a number of substances other than sugars. The number of such substances which undergo a kind of fermentation accompanied by the evolution of carbon dioxide has been greatly extended by NEUBERG and TIR.²⁸ The substances which are fermented in this way by yeasts and yeast preparations are the common plant acids which occur naturally in fruit juices and other substances used in alcohol production, and also components or products of the yeast cell, as fatty acids, glycerine, and lecithin.—H. HASSELBRING.

Soil productiveness indicated by natural vegetation.—The practical object of SHANTZ's Bulletin²⁹ on "Natural vegetation as an indicator of the capabilities of land for crop production in the Great Plains area" does not detract from its scientific value. It is an interesting and valuable example of the application of exact ecological research methods, with results establishing reliable data relating to the natural vegetation of a given region, and its correlation with the crop-producing capabilities of the land. Detailed investigations were made in Washington and Yuma Counties, Eastern Colorado, although a general survey included all the states of the Great Plains, a region containing the largest body of land of possible agricultural importance in the United States on which the native plant cover still exists. The methods included study of the vegetation with respect to the formations, dominant associations, and important species, and of the various determining factors with especial consideration of the physical conditions (temperature, rainfall, evaporation, saturation deficit, soil moisture, soil temperature, etc.). Records for these physical factors were made at 11 different stations on the Great Plains, under direction of BRIGGS, and supplemented by SHANTZ with many comparative observations. For purposes of comparison, the soil moisture determinations were reduced to definite standards, as moisture equivalent and non-available moisture (for Kubanka wheat).

Plant migrations, invasions, effects of fire, grazing, mowing, and other biotic agencies are considered. Illustrations of the root systems of significant species are given and their relations to the soils and in the successions are noted. Indicative of agricultural land are the grama-buffalo grass and the wire grass

²⁸ NEUBERG, C., and TIR, L., Ueber zuckerfreie Hefegärungen. II. *Biochem. Zeitschr.* **32**:323-331. 1911.

²⁹ SHANTZ, H. L., Natural vegetation as an indicator of the capabilities of land for crop production in the Great Plains area. *Bur. Pl. Ind. Bull.* no. 201. pp. 100. *pls.* 6. *figs.* 23. 1911.